REMARKS / ARGUMENTS

1. Claim Objections

The Examiner objected to informalities in the claims. Specifically, the claims ended with semi-colons (";") rather than periods ("."). The claims have been amended to correct this.

Claims 1, 2 and 3 lacked the word "and" between the penultimate and final claim sections, therefore, these claims have been amended to add this word for the purpose of formality.

Claims 4 through 16 started with a lower case "t" in the first word, "the". These claims have been amended to substitute "The", for the purpose of formality.

2. Claim Rejections – 35 USC § 112

The Examiner rejected claims 6, and 11 through 13 under 35 USC §112, ¶2, as being indefinite.

The Examiner rejected claim 6 on the ground that the limitation "1 cm^{-1}" is an unclear dimensional measurement. The Applicant respectfully disagrees. In the field to which this invention relates, the term "linewidth" is well defined and understood in relation to wavenumber as "1 cm^{-1}". Nevertheless, the Applicant has amended claim 6 to replace "1 1 cm^{-1}" with "one wavenumber".

The Examiner rejected claim 11 on the ground that the "diode laser" element lacks an antecedent basis in claim 1. The "diode

laser" element of claim 11 refers to the solid-state laser of claim 1. The Applicant has amended claim 1, deleting "diode" and replacing it with "solid-state reference".

The Examiner rejected claim 13 on the ground that the "transfer function" element lacks an antecedent basis. The Applicant has amended claim 13 to clarify that the detector comprises a "transfer function". Thus, amended claim 12 provides an antecedent basis for the limitation that "the transfer function of the detector is inverted by the use of an adaptive filter".

The Examiner rejected claim "14" on the ground that the "transfer function" element lacks an antecedent basis. However, claim 14 does not mention a "transfer function". The Applicant assumes that the Examiner was addressing to claim ***12***, which includes the transfer function element and limitation. The Applicant has amended claim 12 to clarify that the detector comprises a "transfer function". Thus, amended claim 12 provides an antecedent basis for the limitation that "an additional source of radiant energy is used to probe the transfer function of the detector".

The Examiner rejected claims 15-17 on the ground that the limitation "using the response to a probe signal" lacks an antecedent basis. The Applicant has amended these claims

accordingly.

3. <u>35 USC §103 Rejections</u>

The Examiner rejected claims 1, 4, and 11-15 under 35 USC §103(a) as being unpatentable over U.S. Patent No. 5,963,322 ("Rapp").

Rapp teaches the use of an otherwise conventional interferometric spectrometer, but with an analog-to-digital conversion ("ADC") from the same clock that is used to control the switched power supply. By using the same clock, electromagnetic interference may be the same in all cycles of conversion of the signals, such that it appears as a DC signal that may be electronically or mathematically subtracted. However, Rapp does not discuss or suggest the use of a tunable laser as the source.

The Examiner argues that, although Rapp teaches the use of a gas (HeNe) laser as a reference source, the use of solid-state lasers "are well known" and recognized as functional equivalents of gas lasers, thereby rendering the use of a solid-state reference laser obvious. <u>See</u> 3/12/03 OA. At 4. The Examiner did not identify any reference providing a suggestion or motivation to substitute a solid-state reference laser for a gas laser.

Pursuant to MPEP §706.02(j), "After indicating that the rejection is under 35 U.S.C. 103, the examiner should set forth

in the Office action: (A) the relevant teaching of the prior art relied upon . . . , (B) the difference or differences in the claim over the applied references, (C) the proposed modification of the applied references(s) necessary to arrive at the claimed subject matter, and (D) an explanation why one of ordinary skill in the art at the time the invention was made would have been motivated to make the proposed modification."

MPEP §706.02(j) further provides that "To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations." (Citation omitted.)

MPEP §706.02(j) explains that "The initial burden is on the examiner to provide suggestion of the desirability of doing what the inventor has done. To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention or the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed

invention to have been obvious in light of the teachings of the references." (Citation omitted.)

MPEP §2141.01 provides that "When applying 35 U.S.C. 103, the following tenets of patent law must be adhered to: (A) The claimed invention must be considered as a whole; (B) The references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination; (C) The references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention; and (D) Reasonable expectation of success is the standard with which obviousness is determined." (Citation omitted.)

As set forth in MPEP 2141.01 III, when denying a claim based on obviousness, an examiner cannot view prior art references with the wisdom of hindsight vision afforded by the claimed invention. Instead, the examiner must cast her or his "mind back to the time of the invention, to consider the thinking of one of ordinary skill in the art, guided only by the prior art references and the then-accepted wisdom in the field... Close adherence to this methodology is especially important in cases where the very ease with which the invention can be understood may prompt one to fall victim to the insidious effect of a hindsight syndrome wherein that which only the invention taught is used against its teacher." (Citations and quotations omitted.) <u>See also In re Werner Kotzab</u>, 217 F.3d 1365, 1369 (Fed. Cir.

2000).

The Examiner's assumption, that it would have been obvious to one skilled in the art to substitute a solid-state reference laser for a gas reference laser, is factually incorrect. At the time the instant invention, diode lasers were not known in the field of interferometric spectrometry. No reference to diode lasers can be found in any of the relevant textbooks. See, *e.g.*, Griffiths, Beer, Brault. Even to the present day, almost all interferometric spectrometers continue to use Helium-Neon lasers as optical path difference references, in spite of the disadvantages of cost, heat generation, power dissipation and size. This fact strongly indicates that it is not obvious to substitute a tunable, solid-state reference laser in place of a conventional gas laser. The principal reason that it is not obvious to use a diode laser is that these devices are notorious for their drift with wavelength. Further, it is not obvious how to control the wavelength of a diode laser that is to be used in an interferometric spectrometer to achieve stabilities on the order of part per million. The present application teaches a novel approach to measuring the wavelength of the laser with great accuracy by exploiting the tuning capability of the diode laser.

The Examiner also argues that a solid-state laser is the

"functional equivalent" of an HeNe laser. The Examiner does not identify a reference to support this argument. The Applicant respectfully disagrees. As discussed in the application's "Etalon Standard for Reference Lasers" section, solid-state lasers have not been used as reference lasers in the field to which the application pertains. While solid state lasers have been known for some time, their use as reference lasers in spectrometry was not known at the time of the invention herein.

The Examiner further argues that, although Rapp does not teach the use of a filter with a reference laser, it would have been obvious to one skilled in the art at the time of the invention to do so. The Examiner provided no reference providing a suggestion or motivation to use a filter with a reference laser. The prior art did not suggest the use of filters for reference lasers in spectrometry.

The Examiner also rejected claims 1, 5 and 6 on the ground that vertical cavity surface emitting lasers ("VCSEL") are well known solid-state lasers and it would have been obvious to one of ordinary skill in the art to substitute a VCSEL for an HeNe laser. The Applicant respectfully disagrees. At the time of the invention herein, VCSELs were not used in spectrometry as filtered reference lasers with the control, data acquisition and processing system disclosed in this application. As noted in the specification, and discussed above, prior art spectrometers did

not use or suggest the use of solid-state lasers as reference lasers.

The Examiner rejected claims 2 on the ground that, although Rapp did not disclose a monolithic optical assembly including a roof reflector rigidly coupled to a beamsplitter, U.S. Patent No. 5,949,543 ("Bleier") disclosed these features and it would have been obvious to one skilled in the art at the time of the invention to combine the references. The Examiner does not point out any express suggestion or motivation to combine the references. Moreover, the Applicant respectfully disagrees with the Examiner's interpretation of Bleier and Rapp. Bleier does not disclose a monolithic assembly; rather, Bleier shows and discloses three separate assemblies. Nor does Bleier discuss the use of a roof reflector disclosed in the present application. The Bleier reflector, which is seen in Figures 7 and 8, is a cube corner reflector having a fundamentally different geometry.

Bleier teaches the construction of a particular interferometer geometry, but Bleier does not discuss the use of roof reflectors and neither the term "roof reflector" nor the term "roof retroreflector" appear in Bleier. Nor is any geometry resembling such a roof reflector described or illustrated in any way in Bleier. The substance of Bleier's teaching is a method of construction of a version of an interferometer. It should be noted that the interferometer is not monolithic, because it uses

a second moving assembly, which is a hollow cube corner retroreflector. The geometry taught by Bleier is distinctly different from the geometries disclosed in the present application. The abstract of Bleier recites "a monolithically constructed hollow corner-cube retroreflector, wherein one of the retroreflector panels is a reflecting surface, another panel (situated at a 45 degree angle to the reflecting surface of the first panel) is a beamsplitter". This portion of the abstract is an accurate summary of the geometry as it is taught, with the exception of the misuse of the term "hollow cube-corner retroreflector." The misuse of this term continues throughout the specification. It should be understood that the geometry described by Bleier in the passage quoted above is not in fact a hollow cube-corner retroreflector, though it is erroneously called such. Bleier specifies that the second panel is situated at a 45 degree angle to the reflecting surface. However, a cube has three reflecting facets that are all mutually perpendicular. Thus a cube corner must have facets that are oriented at 90 degree angles, not at 45 degrees. Second, a hollow cube corner retroreflector depends on the action of three reflecting facets. Bleier's next sentence states that the third panel is not a reflector: "and the third panel is a support panel used to complete the construction of the hollow corner-cube retroreflector." But, the third panel is not a reflector.

Even if it were, the resulting three faceted reflector assembly would not be a cube corner, but with only two reflecting facets oriented at 45 degrees, it is neither a cube corner retroreflector, nor a roof retroreflector. Thus the geometry is not a hollow cube corner retroreflector, nor does it contain a roof reflector. As noted above, the term "roof reflector" does not appear in Bleier, nor are any roof reflectors shown in any of the figures in Bleier. The geometry containing a beamsplitter and mirror held together by a third panel does function as a retroreflector so long as it is not tilted. However, were it a true retroreflector, such as the one taught in the present application, the retroreflecting property would be independent of tilt angle. Thus, it is not even a retroreflector in the conventional use of that term. Therefore, the Applicant respectfully submits that the Examiner is mistaken in arguing that Bleier shows a monolithic assembly or a roof reflector.

The Examiner rejected claims 7, 8 and 9, arguing that the claimed manufacturing methods and coatings are obvious. The Examiner did not provide a reference to establish a suggestion or motivation to combine the claimed methods and coatings to roof reflectors.

The Examiner rejected claim 11 on the ground that, although Rapp does not teach demodulation of the reference signal, it was obvious to do so. The usual practice for processing the

reference laser signal is to detect the times of the zero crossings and then to acquire the infrared signal at these times. In the conventional approach, the zero crossings are converted to pulses and used to trigger the analog-to-digital converter. As discussed in the application's specification, Brault and others have taught the approach of digitizing the infrared channel with a clocked analog-to-digital converter, while simultaneously recording information about the times of the zero crossings. Neither of these approaches to processing involve demodulation, nor is demodulation of the reference laser signal taught in any of the textbooks on the subject of Fourier transform spectrometry. Nor is it taught as a method for monitoring, controlling or correcting a diode laser wavelength. Therefore, the Applicant respectfully disagrees with the Examiner's argument and responds that the prior art did not teach the demodulation of reference signals.

The Examiner rejected claim 12 on the ground that, although Rapp does not teach an additional light source to probe the transfer functions of the detector, it would have been obvious to do so. The use of light sources to probe the transfer function of detectors has, to the knowledge of the inventor, appeared only once in the prior art, in the context of a laboratory set up for testing detectors. In that case, Brasunas described the use of modulation frequencies up to 100 Hertz, generated by the use of

LED's. There was no hint in that paper or any other prior art of the possibility of making these components to function as an integral part of a spectrometer to effect an internal calibration. Brasunas did not teach the fact that light emitting diodes could produce modulation frequencies that would be useful to the upper limits of the modulation frequencies employed in Fourier transform spectrometers. Therefore, the technique of using light emitting diodes and other light sources to probe detector transfer functions were not known in the prior art. Nor are these techniques taught in any of the textbooks on the subject of Fourier transform spectrometry, nor in the patent literature.

The Examiner rejected claim 13 on the ground that Rapp teaches filtering algorithms for the detector signal that could include the inversion of the detector transfer function. However, Rapp makes no reference to the existence or usefulness of adaptive filters as a means for inverting detector transfer functions. While Rapp's filter could, as the Examiner points out, include an inversion of the detector signal, it does not teach a method for making such an inversion. Without inversion, knowledge of the detector transfer function is not useful for making corrections to the signals.

The Examiner rejected claims 3 and 10 on the ground that, although Rapp does not teach varying path length by scanning a

compensator plate by nutation, U.S. Patent 4,743,114 ("Crane") teaches the use of a compensating plate scanned by nutation. The Examiner does not identify a suggestion or motivation to combine the references. Crane teaches the use of a nutating etalon as varying spectral filter in which the image transmitted by the filter is continuously moved on an array detector by passing in one direction through the etalon. It should be noted that a typical high-finesse etalon has an output which is spectrally pure. Thus, there is no need to demodulate the images obtained from the detector array. It is an error to construe an etalon as a compensator plate. A compensator plate, as it is known in the art of Fourier transform spectrometry and generally interferometry, is a prism element having no coatings on its surfaces or having anti-reflection coatings on its surfaces. It is not easily confused with an etalon, which has, by definition, reflecting coatings applied to the surfaces that define the limits of the etalon cavity. Further, the effect of nutation in the invention taught by Crane is modulation of the image position on the array detector and adjustment of the wavelengths transmitted by the etalon. In the present invention the compensator plate has no filtering effect, in and of itself. Essentially all of the radiation impinging on the nutating compensator plate is transmitted to an interferometer mirror and then passed again through the compensator plate. The effect is

variation of the optical path difference. The motion of the radiation beam, induced by varying refraction in the crystal, causes the source image to move on the interferometer mirror, much as the image in Crane's invention. However, the return passage through the compensator undoes the motion. The result is a sinusoidal variation of optical path difference that results in signals that are quite difficult to process, unlike these signals detected in Crane's system, which are already spatial-spectral images. The use of a high-finesse etalon, such as the one taught by Crane, in either or both arms of an interferometer would have the effect of reflecting essentially all of the radiation out of the beam path, thereby rendering the device non-functional.

The Examiner rejected claim 14 on the ground that Rapp teaches detecting an optically subtracted beam. The Applicant respectfully disagrees. Rapp teaches the use of an electronically or mathematically subtracted signal, but not an optically subtracted signal, as disclosed in the present invention.

The Examiner rejected claims 15 through 17 on the ground that Rapp teaches modifying detector signals for non-linearity. While Rapp teaches the use of a correction for detector non-linearity, Rapp does not address the use of a probe signal for the purpose of measuring the degree of non-linearity as a step in making the correction. Thus, the substance of claims 15-

17 is novel over Rapp's teachings.

4. CONCLUSION

In view of the above remarks, the Applicant respectfully requests reconsideration of the claims as amended and allowance of same.

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Respectfully submitted,

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